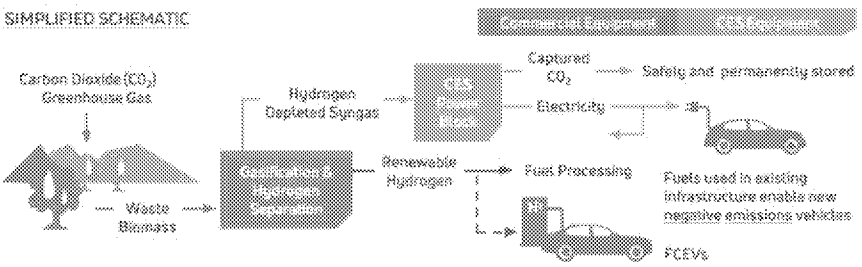
CLEAN ENERGY SYSTEMS

Mendota Carbon Capture & Storage Project

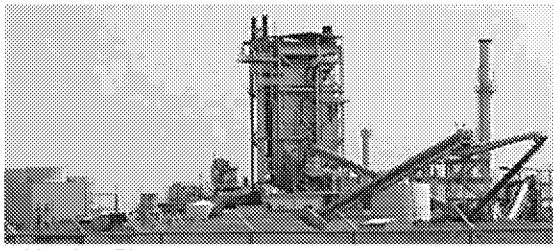
What is Carbon Negative Energy?

The Mendota Clean Energy Systems project will deliver power to local communities while capturing CO_2 before it is released into the atmosphere. To achieve this, Clean Energy Systems (CES) has developed a Carbon Negative Energy (CNE) plant that gasifies waste biomass fuels to produce a synthesis gas. This "syngas" is then used to produce renewable hydrogen and/or electricity while capturing CO_2 with CES' proprietary oxy-combustion technology. By using fuel that consumes carbon over its lifetime (biomass) and safely and permanently storing all produced carbon dioxide, the results are net-negative carbon emissions. This fact sheet provides a high-level overview of the steps that have been taken to ensure the safe and permanent storage of CO_2 in the subsurface at the Mendota biomass plant site.



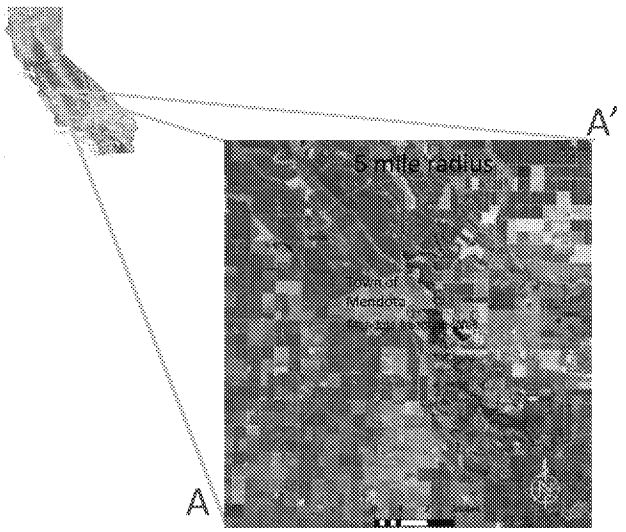
Project Goals

The goal of carbon capture and storage (CCS), also known as carbon sequestration, is to safely and permanently store industry produced carbon dioxide within saline reservoirs deep underground. To understand the feasibility and efficacy of geologic storage at the Mendota biomass plant, Schlumberger has completed detailed subsurface modeling and dynamic flow simulations to assist in ascertaining whether the injected CO_2 will be safely contained deep underground.

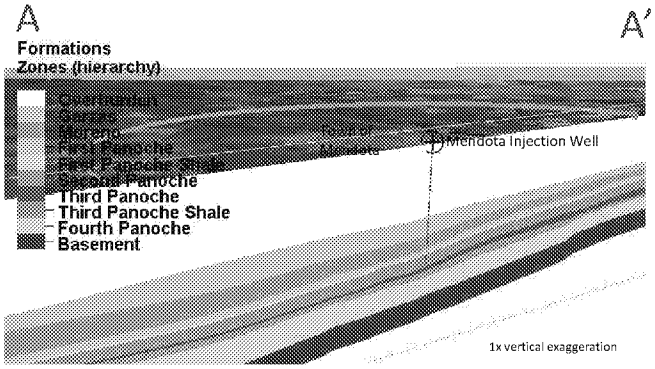


Mendota Plant

The CO_2 source for this project is captured from the CES proprietary gas generator using biomass fuel.



Location of proposed CO_2 injection well



Geologic formations at the Mendota site.

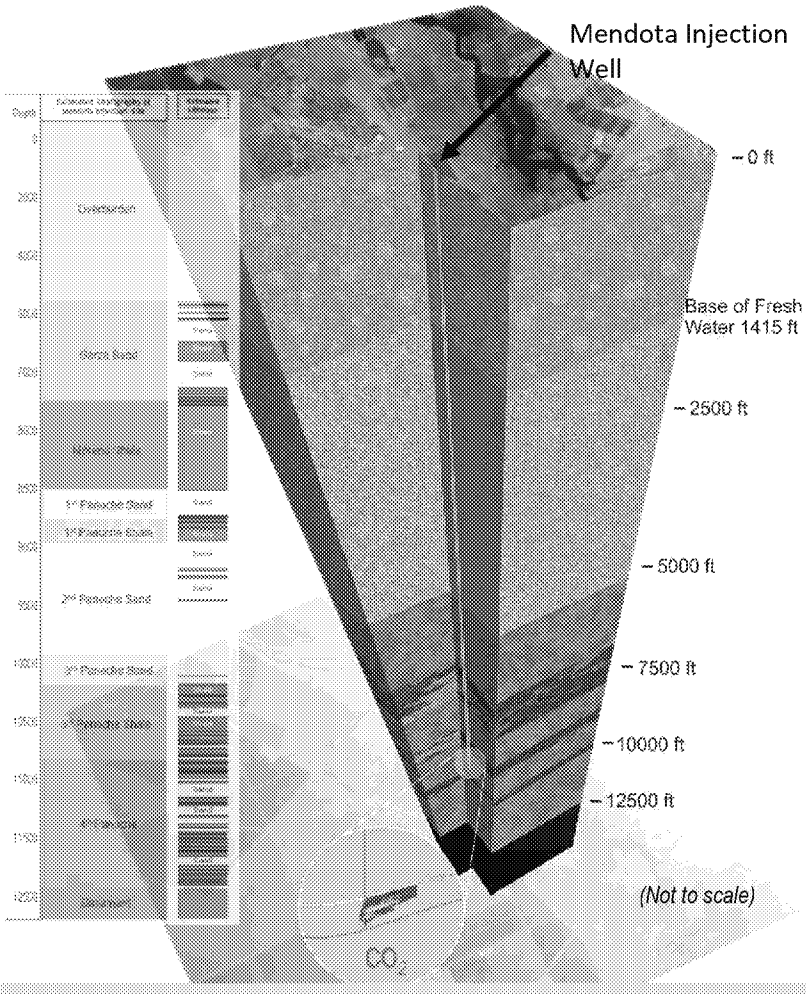
Location: Mendota, California
Injection zone (proposed): 2nd Panoche Sand
Depth: 9,000 ft
Cap rock: 1st Panoche Shale (primary), Moreno Shale (secondary)
Injection rate (proposed): 350,000 tonnes/year for 20 years

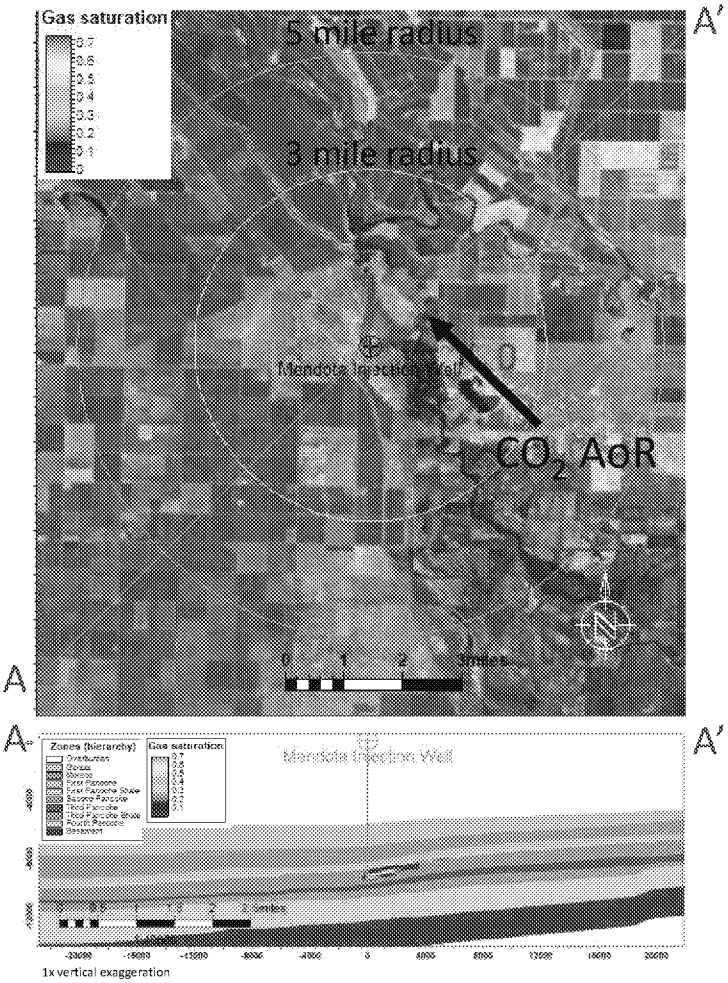
The Mendota Carbon Capture & Storage project is CES's first proposed long term geologic storage project where the CO_2 captured from the oxy-combustion of biomass fuel will be injected and contained within deep saline reservoirs.

Pre-Construction Feasibility Study

Preliminary static and dynamic flow modeling under the proposed Mendota injection site was conducted to better understand the feasibility of CO_2 sequestration. Review of publicly available works and preliminary mapping show that at the prospective injection location there are a series of deep submarine fan systems (Panoche sandstones and shales) (California Geological Survey, 2006) that create multiple stratigraphic traps that can be ideal for geologic storage.

A static geologic model provides the framework for dynamic simulation of the predicted CO_2 plume extent, or the Area of Review (AoR). Regulatory agencies use the AoR to identify where a CCS project must demonstrate that underground sources of drinking water are protected (EPA, 2013). Similarly, (CARB 2018) requires the delineation of storage complex boundary in the subsurface to protect public health and the environment from atmospheric leakage. The AoR and storage complex boundary provide the groundwork to better develop strategies for the deployment of technologies that will monitor the injected CO_2 during the injection and post injection periods. The preliminary evaluation conducted for the conditional permitting process indicates that the Panoche sandstones could allow for the safe injection and containment of CO_2 9,000 feet underground.





Simulated CO_2 extent (upper) and saturation profile (lower) along A-A' after 20-yr injection delineated by reservoir simulation

Path Forward

Once conditional approval for this project is granted by regulatory agencies, CES will pursue the acquisition of site specific data (seismic survey and characterization well data for example) to validate the feasibility of this site for geologic storage. The iterative deployment of subsurface monitoring technology and subsequent dynamic modeling will be the vehicle to demonstrate successful carbon sequestration on a long-term commercial scale. By using CES technologies in conjunction with Schlumberger's worldwide carbon sequestration expertise, the Mendota CCS project offers the opportunity to deliver safe, reliable and sustainable negative carbon emissions power and cleaner future for all of us.

References

California Air Resources Board (CARB) (2018), Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard.

Environmental Protection Agency (EPA) (2013), Geologic Sequestration of Carbon Dioxide - Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance.

California Geological Survey (2006), An overview of Geologic Carbon Sequestration Potential in California

Clean Energy Systems technology enables cleaner and more efficient co-generation of power, steam, water, and CO_2 and offers the world a new perspective on the way we assess the value of natural resources. Working with Schlumberger, CES will safely and permanently store CO_2 with the Mendota Carbon Capture and Storage project. To learn more, please contact

Rebecca Hollis, Business Development Director, (916) 638-7967, rhollis@cleanenergysystems.com

CLEAN ENERGY SYSTEMS

Schlumberger